THE NEW RESEARCH CENTER MATHEMATICS FOR KEY TECHNOLOGIES IN BERLIN

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The German Science Foundation *Deutsche Forschungsgemeinschaft (DFG)* has established a new reseach center

Mathematics for key technologies: Modelling, simulation, and optimization of real-world processes

in Berlin. The center is funded by DFG with 5 Million EURO per year. It is operated and cofinanced with 3 Million EURO per year by the three Berlin Universities: Free University (FU), Humboldt University (HU) and Technical University (TU) the leading institution, together with the two research institutes: Konrad-Zuse Zentrum für Informationstechnik (ZIB) and Weierstrass Institute for Applied Analysis and Stochastics (WIAS). The center was opened November 20–22, 2002 at Technical University of Berlin with a three day workshop that started with a *Mathematical firework*. This firework, with talks for the general public including 3D mathematical visualizations, drew a spectacular audience of more than 1000 people. It received a large and enthusiastic echo from the audience and the media.

History of the Center. In August 2000 the *DFG* (as a result form funding obtained through the UMTS licence auction) started a new program to establish several centers of excellence in research in Germany. The first call was open to all fields of research and drew more than eighty proposals. In the first round three centers were granted with the topics *Ocean Rims* in Bremen, *Functional Nanostructures* in Karlsruhe and *Experimental Biomedicine* in Würzburg.

The second call that was more specific came in early 2001 and was devoted to the topic of *Modelling and Simulation in Science, Engineering and Social Science*. A joint mathematics proposal was written by mathematicians from the Berlin universities and research centers. The proposal was coordinated by Martin Grötschel (TU and ZIB and chairman of the center), Volker Mehrmann (TU and vice-chairman of the center), Peter Deuflhard (FU and ZIB), Hans Föllmer (HU) and Jürgen Sprekels (HU and WIAS) and had 14 strong competitors, many of them with participation from other mathematics departments. In July 2001 we learned that we were among the three finalists which then had to prepare a detailed proposal (a densely packed book of 400 pages). In January 2002 the finalists had to defend their proposals in competition before an international group of reviewers. The final decision in May 2002 was based on the rule *the winner takes it all*. It saw two very strong but disappointed runners-up who had spent as much time and energy on their application as we did.

Since the decision was made, the activity within the center has grown immensely. The administration of the center had to be set up, the facilities for the center have to be prepared (it will occupy a large part of the mathematics building of TU Berlin). Furthermore, most important, about 60 researchers, 7 assistent professors and 7 full professors including the areas of *Applied Analysis, Numerical Analysis, Stochastics, Optimization, Visualization, Discrete Mathematics, Scientific Computing* have to be hired. The current grant is for four years and it has a maximal life-time of 12 years with two evaluations on the way.

Mission of the center. Since modern key technologies need more and more complex modelling, simulation and optimization techniques and since innovation cy-

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cles in technological development get shorter and shorter, it is essential to have flexible mathematical models that allow to master complexity, to react quickly, and to explore new smart options. Such models can only be obtained via abstraction. This line of thought provides our global vision: *Innovation needs flexibility, flexibility needs abstraction, abstraction is mathematics.* But mathematics is not only the language of science, it provides theoretical insight, efficient algorithms and optimal solutions. Thus, key technologies and mathematics interact in a joint innovation process. We think that new products in key technologies should carry a stamp **Mathematics inside**.

The mission of the center is to strengthen the role of mathematics in this interactive process. In order to achieve this, the center's research program is application-driven but we do basic research in mathematics and we envision that it will also have a strong impact on the development of many other areas of mathematics. We also hope that the activities of the center will increase innermathematical, interdisciplinary and transdisciplinary cooperation.

The center focuses on the mathematical fields of *optimization and discrete mathematics, numerical analysis and scientific computing and applied and stochastic analysis* and, building on existing cooperations, it will address the following key technologies:

- Life sciences (computer-assisted surgery; patient-specific therapies; protein data base analysis; protein conformation dynamics)
- Traffic and communication networks (planning of multi-level and multi-layer communication networks; planning of the UMTS radio interface; line planning, periodic time-tabling, and revenue management in public transport)
- Production (shape memory alloys in airfoils; production of semiconductor crystals; methanol fuel cell optimization; online production planning)
- Electronic circuits and optical technologies (quantum mechanical modelling of optoelectronic devices; design of nano-photonic devices; integrated circuits for future chip generations)
- Finance (measurement and hedging of risks; interaction models for asset price fluctuation)
- Visualization (discrete differential geometry; image processing).

The center is not only a mathematical research institution, it also aims at cooperation with other sciences, engineering and economics and, in particular, with partners in commerce and industry. Furthermore, the center will also put a strong emphasis on changing the public awareness for mathematics and will contribute to mathematical education on all levels.

The center has just begun to design and develop its web-presentation, for further information see:

h$ttp://www.math.tu-berlin.de/DFG-Forschungszentrum/$